Gurudas College (CU)

Internal Examination 2020

B.Sc Part II

Physics Hons (PHSA)

Paper – IVB

Time: 1 Hr Full Marks: 25

Answer ***any one*** of the following

1. Using monochromatic light of known wavelength, Newton's rings were obtained with a plano-convex lens whose curved surface is placed in contact with a plane glass plate.

   Marks distribution:
   1) Theory: 3
   2) Plot the data for D^2_{p+n} versus n graph of the rings for different orders in a *mm* graph paper: 12

Order No (n)	10	15	20	25	30	35	40	45	50
D_{p+n} (in mm)	3.5777	4.04969	4.46094	4.92950	5.34789	5.64800	6.01664	6.37965	6.70894

   3) Calculation of radius of curvature (R) of the lens from graph: 3
   4) Calculate of percentage of error in R = 2
   5) What do you mean by interference? What are the different types of interference? What type of interference is observed in Newton's ring? 1+1+1
   6) What happens if white light is used instead of monochromatic light in Newton's ring experiment? 2

2. The slit width 'a' and separation between the slits 'b' of a double slit was measured by observing the diffraction and interference fringes.

   Marks distribution:
   1) Theory: 3
   2) Calculate the slit width 'a' from the recording of the following data: 5

No of dark diffraction fringes with respect to the central bright fringe	Recording of the scale in cm as observed through the telescope	
	r→ l	l→r
1	26.6	26.6
2	26	26.1
3	25.5	25.5
4	24.2	24.1
5	23.7	23.7

[Supplied data: λ = 589 nm, D = 139 cm]

3) Calculate the the separation 'b' between slits from the recording of the following data: 5

Order no of dark interference fringes with respect to the central bright fringe	Recording of the scale in cm as observed through the telescope	
	r→ l	l→r
1	25.1	25.1
2	25	25
3	24.8	24.8
4	24.7	24.6
5	24.5	23.5

4) Calculate the maximum percentage error in 'a' and 'b' from the recorded data: 2
5) Evaluate the quantity, $N = 2\frac{b}{a} + 1$, using the optical measurement data. What does this quantity signify? 2+1
6) What do you mean by interference? What is diffraction? What are the differences between interference and diffraction? 2+2+3

3. A solution of 16% concentration using a given optically active solute was prepared and the rotation of the plane of polarization was measured for five different concentrations by volume of the optically active solution.

Marks distribution:
1) Theory: 3
2) Calculate and draw the calibration curve and find the specific rotation from the following data: 5+5+2

[Supplied data: V.C. of polarimeter – 0.1°]

No of obs	% strength of the solution	Vernier	Readings of the Vernier ()	
			Circular Scale reading in degree	Vernier Scale reading
1	16	1st	342	3
		2nd	162	8
2	14	1st	340	7
		2nd	160	9
3	12	1st	338	3
		2nd	158	4
4	10	1st	336	9
		2nd	156	4
5	8	1st	334	2
		2nd	154	7
6	Plane water	1st	323	2
		2nd	143	5

3) Estimate the percentage error in specific rotation: 3
4) Write down the parameters on which specific rotation depends: 2
5) What is polarization? What are ordinary and extraordinary rays? 1+(1+1)
6) State Brewster's law. 2

4. With the help of a ballistic galvanometer, the deflection (d) versus dial reading (θ) for the determination of mutual inductance (M) of the given pair of coils, kept at different positions from 0° to 180° was recorded.

   Marks distribution:
   1) Theory + Circuit: 4+2
   2) Draw (d-θ) graph from the recording of data for 'd' and θ: 12

Dial reading	Ballistic throw in cm
0°	23.25
20°	22
40°	15.53
60°	8.67
80°	4.19
90°	0.75
100°	1.45
120°	5.94
140°	11.17
160°	18.1
180°	23.77

   3) What is ballistic galvanometer? What is its CDR? 2+1
   4) What is mutual inductance? What is its unit? 1+1
   5) State Lenz's law. 1
   6) What is log decrement of a ballistic galvanometer? 1

5. The resonance curve data of a circuit containing a capacitor (C), a resistor (R) and a coil of unknown inductance (L) connected in series with an a.c. supply was recorded.

   Marks Distribution:
   1) Theory + Circuit = 4 + 2
   2) Draw the resonance curve from the record of the voltage (V_R) across R for different frequencies of the fixed input voltage (V_i): 10

   [R = 100 Ω and C = 0.1 μF]

Frequency in Hz	3600	3900	4200	4500	4550	4800	5100	5500	5700
r.m.s. voltage across 'R' in V	1.12	1.45	1.63	1.6	1.59	1.4	1.17	0.93	0.83

   3) Determine the resonance frequency: 2
   4) Determine the value of L: 2
   5) Determine Q factor from graph: 2
   6) Why a series LCR circuit is called an acceptor circuit while a parallel LCR circuit is called a rejecter circuit? 3

6. In the given (Fig. 1) Wheatstone Bridge network, a variable load resistance (R_L) is connected in a diagonal position. Measurement for voltages and current for different values of the resistances were done using suitable meters.

Marks distribution:

1) Theory with circuit diagram = 5+3
2) The following data was obtained from the measurement:

R_L (Ω)	90	170	190	210	230	250	300
V_L (V)	2.15	3.2	3.4	15	14	14	4.22
I_L (mA)	21	17	16	15	14	14	13

Plot of V_L-I_L graph = 4

3) Calculate V_{Th}, R_{Th} and I_N from theory and graph = 2+2+2
4) Calculation of Load Power P_L: 2
5) Graph of P_L-R_L: 3
6) Find the value of R_L from maximum P_L and compare it with the theoretical data: 2

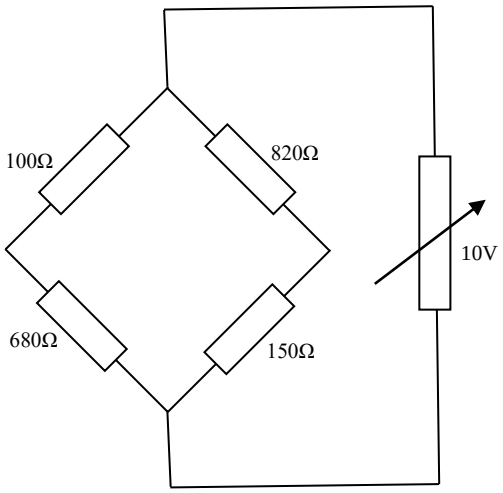

Fig. 1

7. Determination of the band gap energy of a given semiconductor sample was done using four-probe method and the following data was recorded for the study of the variation of voltage (V) with temperature (T°K) at a constant current (I).

[Supplied data:
Distance between the probes (s) = 2 mm
Thickness of the crystal (w) = 0.5 mm
Correction Factor = 5.67]

Marks distribution:

1) Write the theory along with the circuit diagram: 5+2
2) Calculate resistivity (ρ) from the following data and draw $\log_e\rho$ versus $\frac{1}{T}$ graph. Hence, calculate and determine the value of energy band gap (E_g) of the given sample: 4+3+2

Temp (K)	307	317	327	337	347	357	362	367	372
Voltage (V)×10^{-3}	177.1	174	163	142	116	90.6	79.5	69.3	66.9

3) Write down the differences between conductor, semiconductor and insulator materials: 3
4) Why four probe method is used instead of two probe method to measure the band gap of a semiconductor? 3
5) Why correction factor is used in this experiment? 3